Supplementary Material

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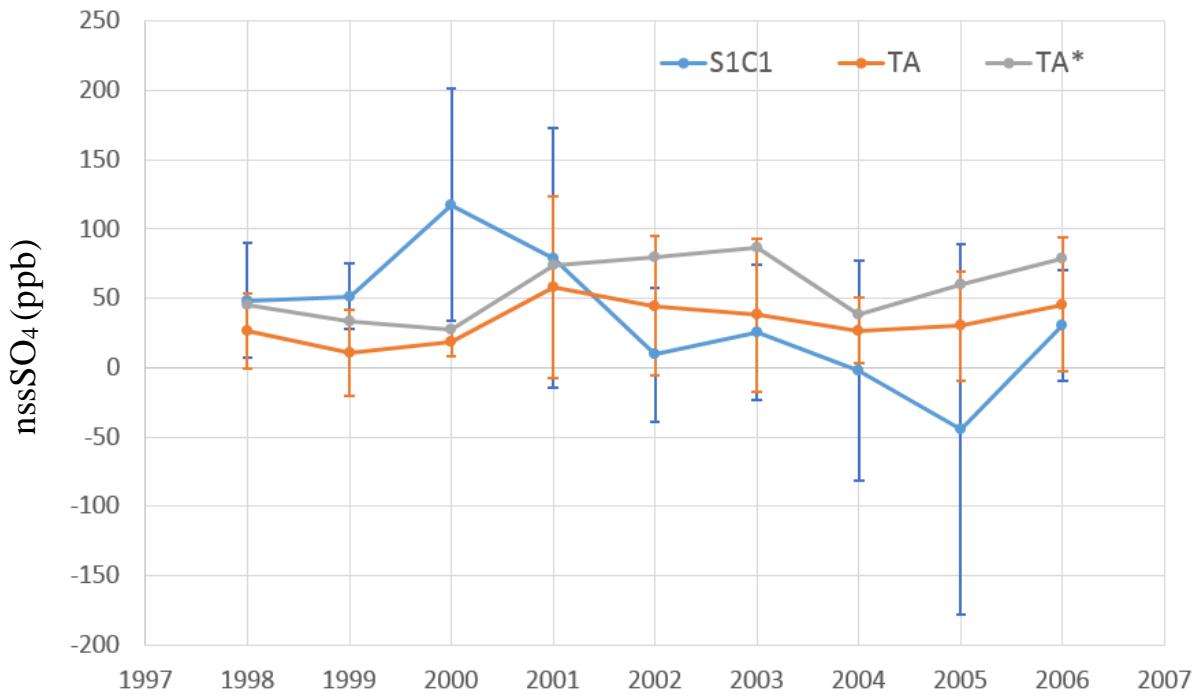
S1: Non sea-salt sulfate ("nssSO$_4$", in ppb) measured along the S1C1 firn core, the TA192A firn core ("TA") based on summer fractionation only and along the TA192A firn core based on summer fractionation for spring to summer seasons and winter fractionation for autumn to winter seasons ("TA*"), over their common period 1998-2006.Vertical lines correspond to standard deviation (± 1).

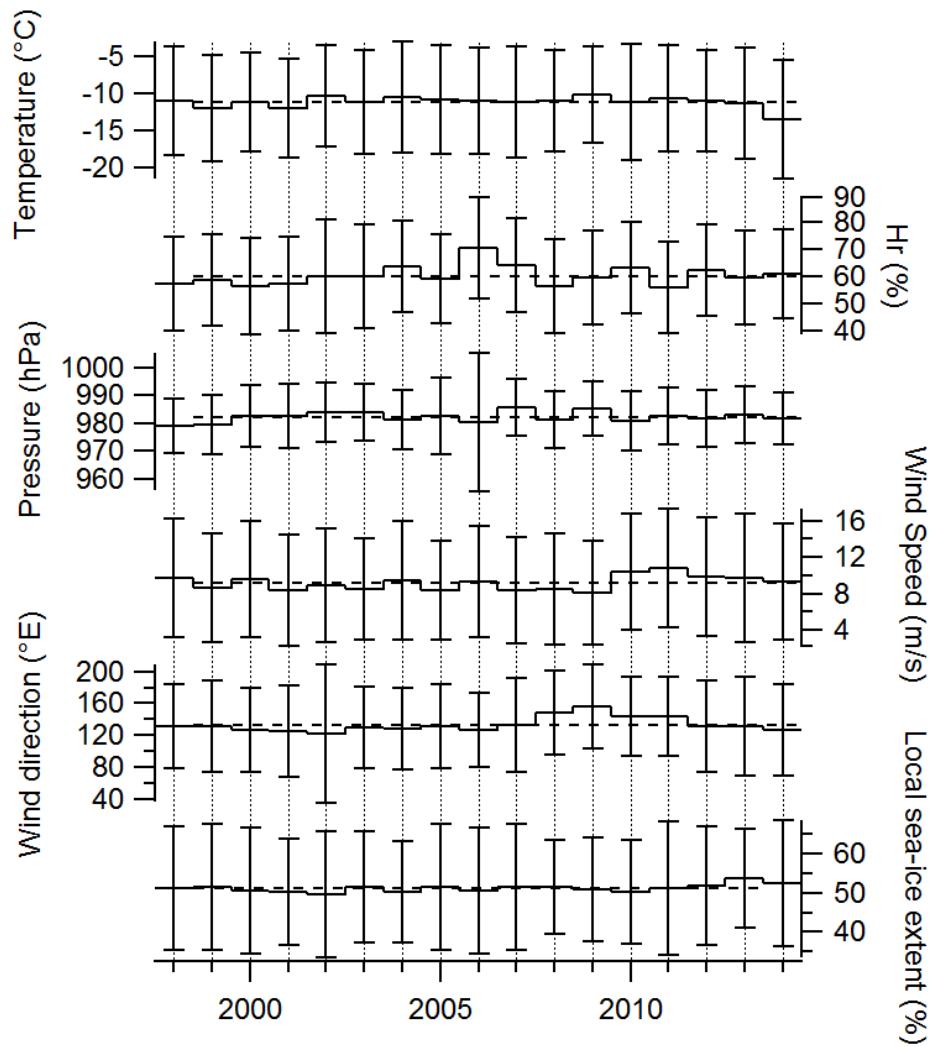
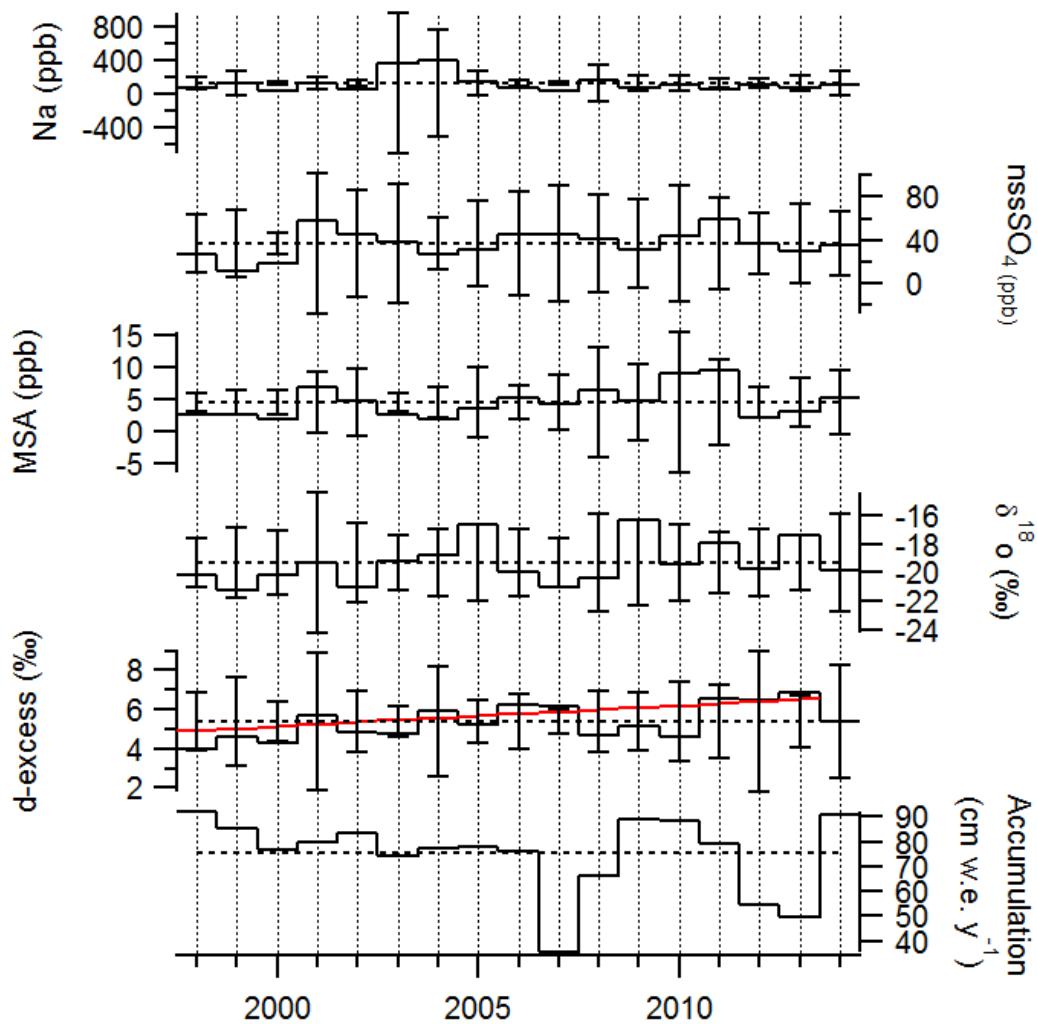
S2: Total mean δ¹⁸O seasonal amplitude (in ‰) and ratio of the three first years mean δ¹⁸O seasonal amplitude by the mean δ¹⁸O seasonal amplitude.

Station	Recorded period	Total mean seasonal amplitude (‰)	Ratio
GIP	2000-2007	15.1	1.2
BI	1996-2014	9.7	1.1
KM	1995-2014	7.0	1.5
KC	1958-2012	1.9	1.0
DSSA	1986-1992	8.0	1.2
NUS 08-7	1382-2008	0.8	8.7
WDC06A	-50-2005	1.8	2.9
IND25B5	1902-2006	4.4	1.2
TA192A	1998-2014	8.6	0.5

S3: Total mean deuterium excess seasonal amplitude (in ‰) and ratio of the three first years mean $\delta^{18}O$ seasonal amplitude by the mean $\delta^{18}O$ seasonal amplitude.

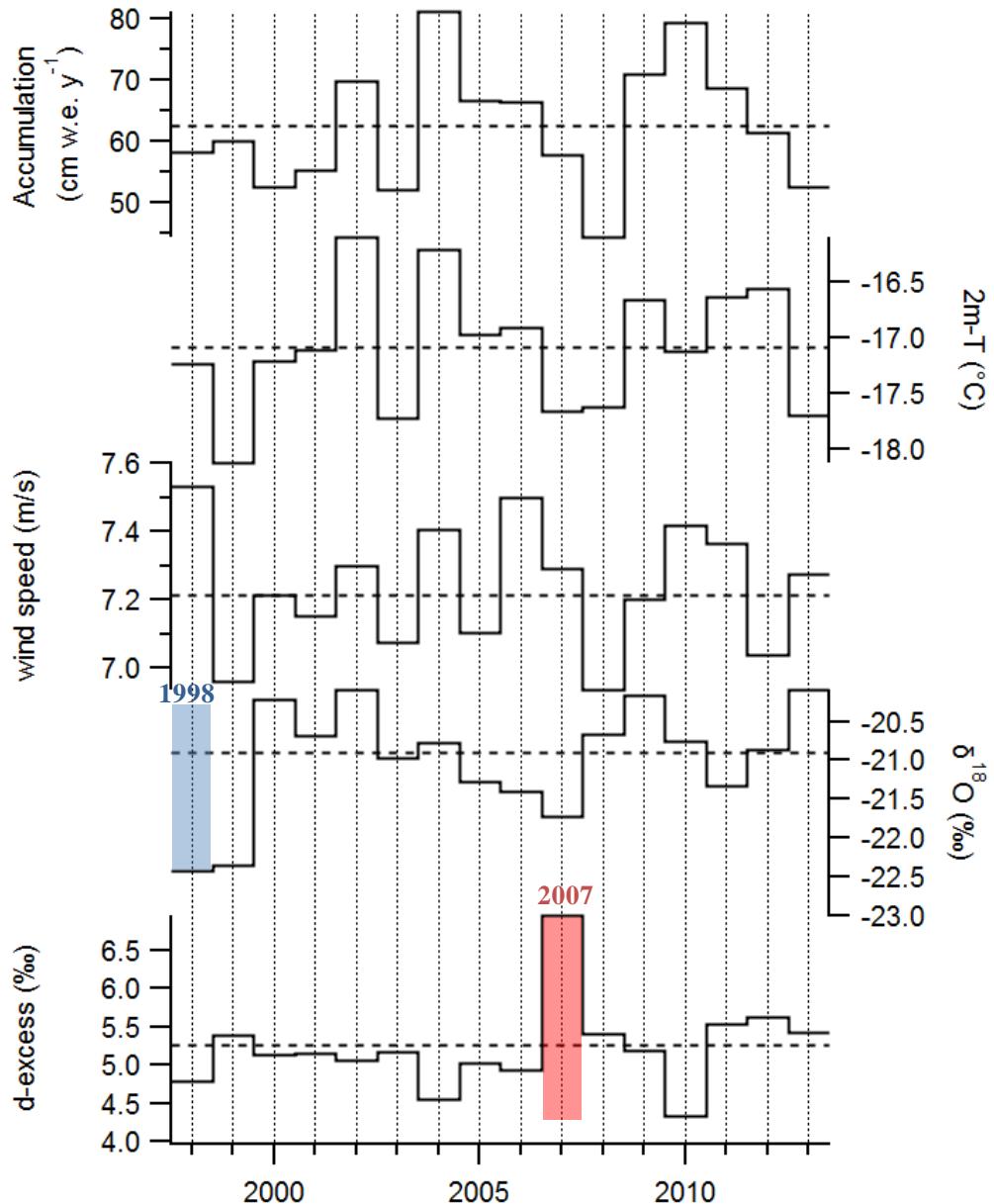
Station	Recorded period	Total mean seasonal amplitude (‰)	Ratio
GIP	2000-2007	17.8	1.4
BI	1996-2014	6.3	1.1
KM	1995-2014	5.5	1.4
KC	1958-2012	2.7	1.0
DSSA	1986-1992	5.3	1.1
NUS 08-7	1382-2008	1.9	4.1
WDC06A	-50-2005	3.2	1.1
IND25B5	1902-2006	7.6	0.9
TA192A	1998-2014	6.5	1.1

S4: Percentage of annual precipitation for the summer, from December to February ("DJF"), the autumn, from March to May ("MAM"), the winter, from June to September ("JJAS") and the spring, from October to November ("ON"), within each year from 1998 to 2014 simulated by ERA-interim.

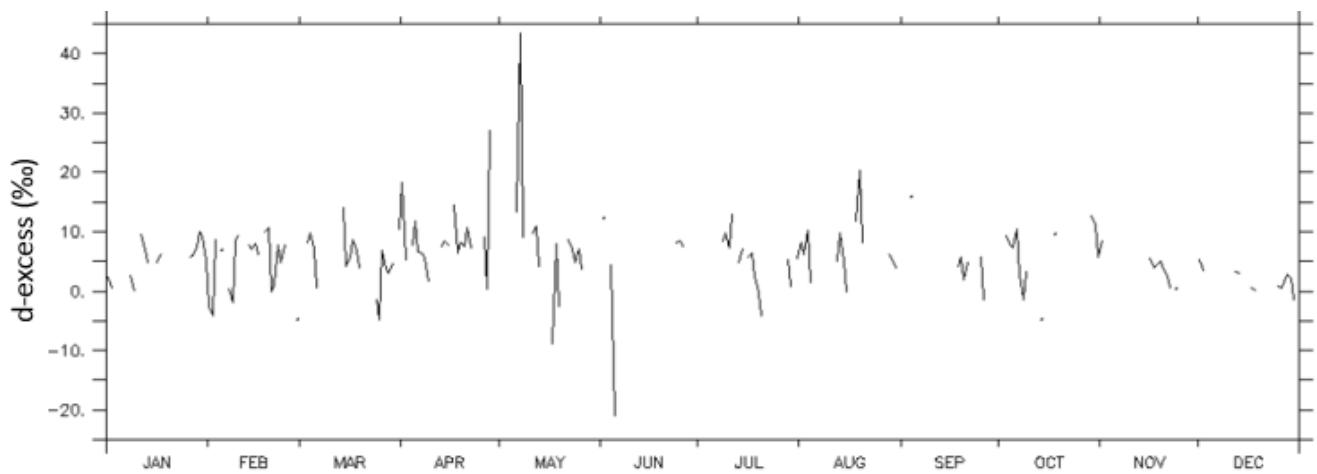
Year	DJF	MAM	JJAS	ON
1998	22.4	36.0	33.2	8.4
1999	37.9	18.4	33.0	10.6
2000	22.5	16.6	47.4	13.5
2001	24.8	35.6	31.3	8.2
2002	31.4	22.1	36.3	10.2
2003	33.3	13.7	46.4	6.6
2004	15.3	33.8	45.2	5.8
2005	22.5	20.4	27.3	29.8
2006	25.6	40.7	26.0	7.7
2007	32.3	34.5	26.3	6.9
2008	15.3	35.2	39.4	10.0
2009	24.7	26.3	45.9	3.1
2010	31.6	22.8	27.4	18.3
2011	32.9	20.4	27.5	19.2
2012	28.2	19.7	43.7	8.4
2013	26.3	26.8	41.0	5.9
2014	40.3	31.7	23.6	4.3

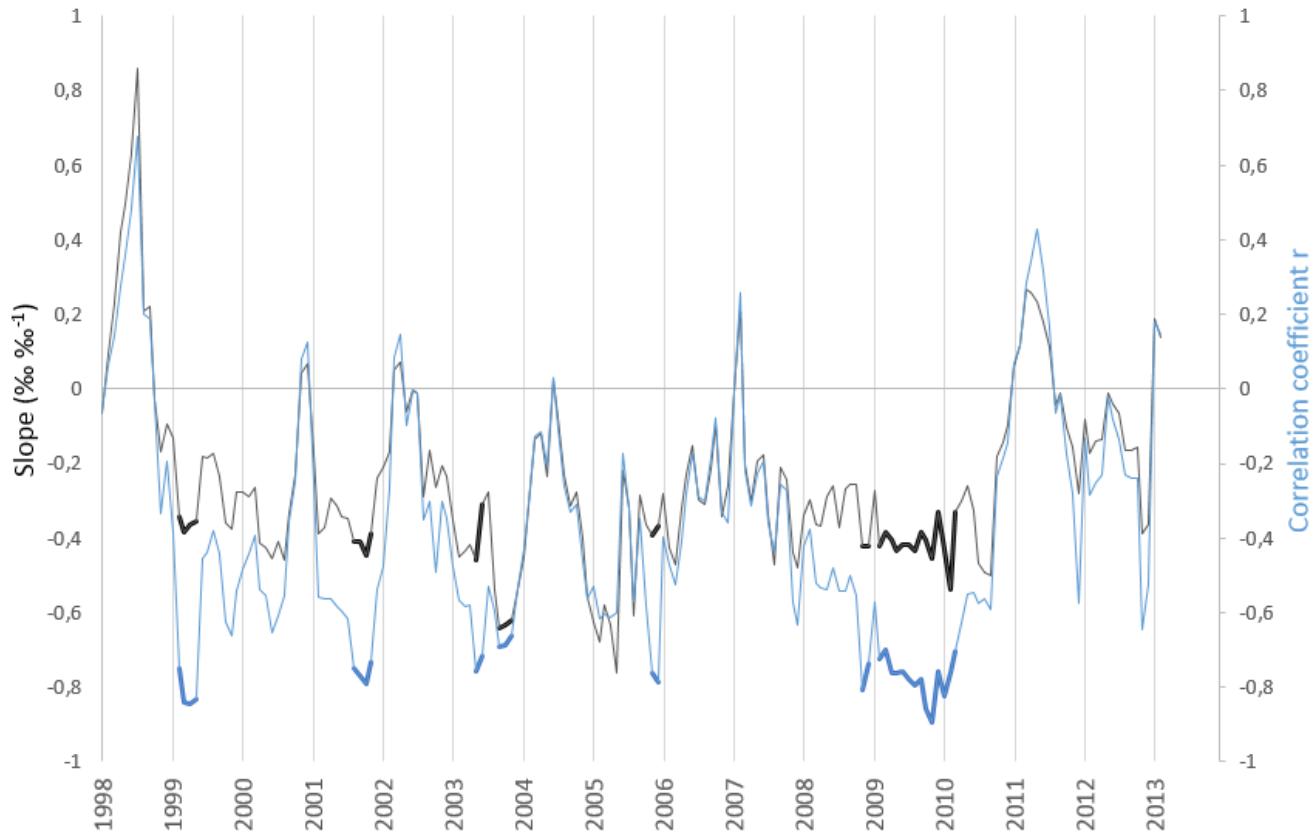
S5: Meteorological time series over the period 1998-2014 averaged at the inter-annual scale. Near-surface temperature (in °C). Relative humidity (in %). sea level pressure (in hPa). wind speed (in m/s) and direction (°E) were provided by Meteo France. The local sea-ice concentration (in %) is extracted in the 135°E-145°E sector (with a latitudinal range of 50°S-90°S) from the Nimbus-7 Scanning Multichannel Microwave Radiometer (SMMR) and Defense Meteorological Satellite Program Special Sensor Microwave/Imagers - Special Sensor Microwave Image/Sounder (DMSP SSM/I-SSMIS) passive microwave data (Cavalieri et al., 1996). Horizontal dashed lines correspond to the climatological averages over 1998-2014 while the vertical solid lines correspond to the standard deviations.

S6: Dated TA192A ice core annually averaged records over the period 1998-2014: accumulation (in cm w. e. y⁻¹), concentrations of Na+ (in ppb), nssSO₄ (in ppb), MSA (in ppb), δ¹⁸O (in ‰) and d-excess (in ‰). Horizontal dashed lines correspond to 1998-2014 average values and vertical bars indicate the intra-annual standard deviation from resampled values.

S7: Mean seasonal amplitude ("μ", in ‰) and standart deviation ("σ", in ‰) of δ^{18}O and deuterium excess ("dxs") from precipitation data from our database

Site	Monitoring / recorded period	μ(δ^{18}O)	σ(δ^{18}O)	μ(dxs)	σ(dxs)
Vernadsky	1964-2013	9.0	2.0	21.4	9.6
Halley	1965-2014	16.3	4.1	17.2	8.6
Marsh	1990-1991	10.7	3.4	23.8	0.8
Rothera	1996-2014	9.8	2.7	16.7	7.6
Neumayer	1981-2000	19.9	5.6	17.7	6.8
Dome F	2003-2004	33.7	15.3	94.2	25.3
Dome C	2007-2010	31.4	11.0	67.0	14.8
GIP	2000-2007	15.1	3.6	17.8	16.2
BI	1996-2014	9.7	2.9	6.3	3.0
KM	1995-2014	7.0	3.0	5.5	2.4
KC	1958-2012	1.9	1.4	2.7	1.3
DSSA	1986-1992	8.0	2.8	5.3	1.0
NUS 08-7	1382-2008	0.8	1.1	1.9	1.7
WDC06A	-50-2005	1.8	1.1	3.2	1.0
IND25B5	1902-2006	4.4	2.1	7.6	6.4
TA192A	1998-2014	8.6	2.1	6.5	2.8

S8: Time series of the simulated accumulated (i.e. precipitation minus evaporation, in cm w.e. y⁻¹), 2-meter temperature ("2m-T", in °C), wind speed (in m s⁻¹), precipitated δ¹⁸O (in ‰) and precipitated d-excess (in ‰), by the ECHAM5-wiso model at the annual scale over the period 1998 – 2014. Shaded vertical lines show outstanding years (i.e. associated with values out of the range defined by mean ± 2 x standard deviation). Shading is in red when higher than the upper bound of this range, while it is in blue when lower than the inferior bound.

S9: ECHAM5-wiso outputs simulated (a) from the 6th to the 08th of May in 20007 and averaged over the period 1979-2013: 2-meter temperature (2m-T, in °C), precipitation (in mm w.e. month^{-1}), zonal wind component (in m s^{-1}), meridional wind component (in m s^{-1}), the geopotential height at 500 hPa (z500, in m), the δ^{18}O (in ‰) and the d-excess (in ‰). Outputs simulated the 07th of May are highlighted using italic and bold formats; and (b) for the deuterium excess ("d-excess", in ‰) at the daily scale over the whole year 2007.

Date	2m-T (°C)	Prec. (mm w.e. month^{-1})	u10 (m s^{-1})	v10 (m s-1)	z500 (m)	δ^{18}O (‰)	d-excess (‰)
06/05/2007	-21.3	0.9	-0.5	6.2	4870.8	-21.6	13.4
07/05/2007	*-22.4*	*0.2*	*-0.8*	*3.4*	*4897.0*	*6.2*	*43.3*
08/05/2007	-20.8	0.1	0.3	6.6	5014.5	-13.7	9.1
06/05 1979-2013	-23.7	40.4	-2.4	7.2	4970.3	-24.4	8.0
07/05 1979-2013	*-23.0*	*50.8*	*-2.7*	*7.0*	*4994.3*	*-22.1*	*7.9*
08/05 1979-2013	-22.0	66.4	-2.6	6.9	5002.6	-22.0	5.9

(a)

(b)

S10: Slope (‰ ‰⁻¹) and correlation coefficient of the running d-excess versus $\delta^{18}O$ linear regressions over 10 points based on the $\delta^{18}O$ and d-excess simulated in the precipitation by the ECHAM5-wiso model. at the corresponding grid point to the TA192A drilling site. Only the results of the significant relationships are given. The date associated with the results correspond to the first point of the regression.

S11: Mean values of Na$^+$ (in ppb), non sea-salt sulfate based on summer fractionation only ("nssSO^4") (in ppb) and methane sulfonate ("MSA") (in ppb), recorded in the S1C1 and the TA192A firn core ("TA"), as well as the ratio of the TA/S1C1 mean values ratio. Numbers into bracket correspond to the standard deviations.

	Na$^+$ (ppb)	nssSO$_4$ (ppb)	MSA (ppb)
S1C1	395.6 ($\pm$154.7)	34.9 ($\pm$33.2)	5.2 ($\pm$3.6)
TA	284.6 ($\pm$124.5)	44.3 ($\pm$13.9)	2.6 ($\pm$1.6)
TA/S1C1 ratio	0.7	0.8	0.5